OIPE
FEB 10 2006
PATENT & TRADEMARK OFFICE

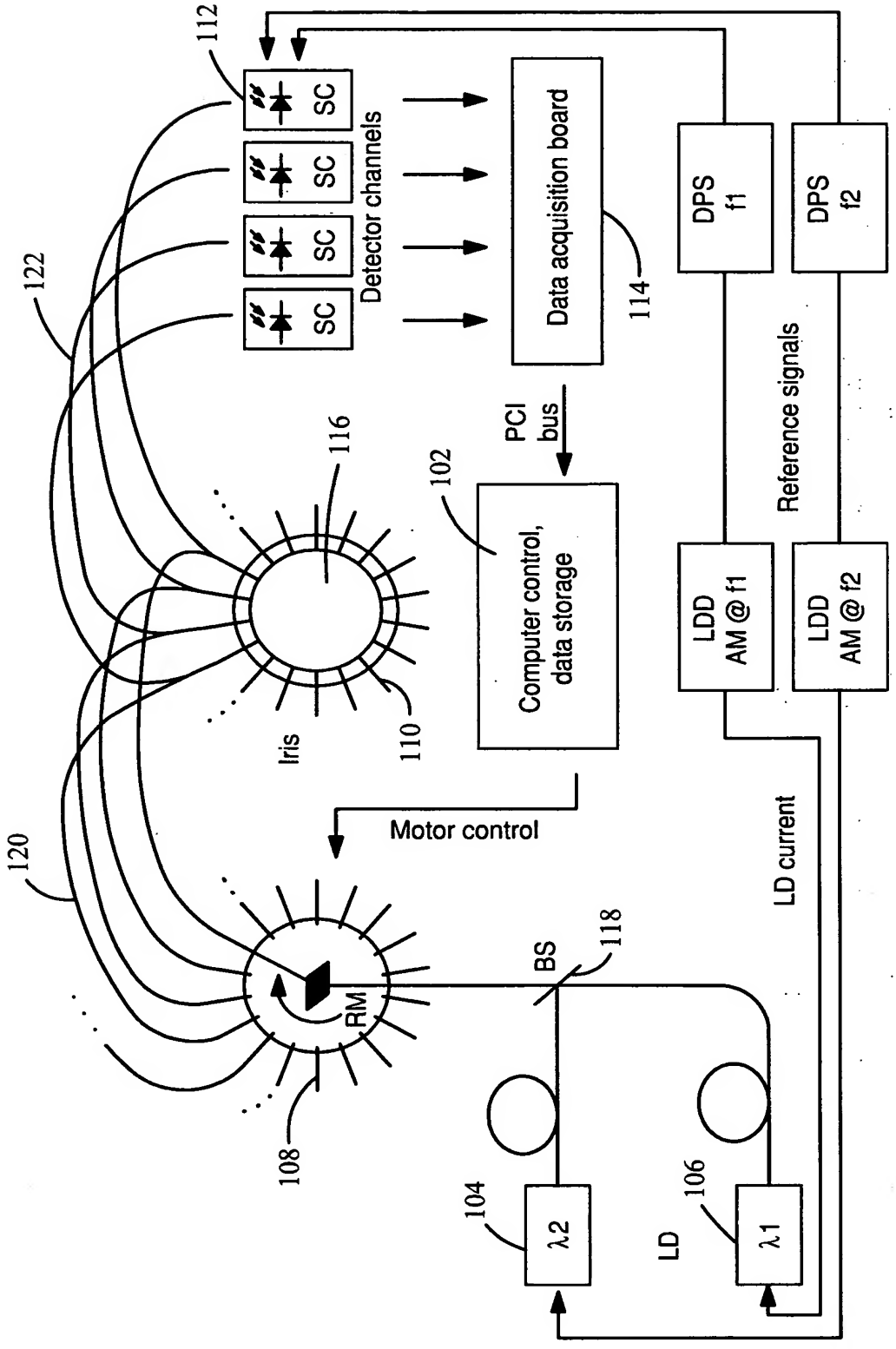

FIG. 1

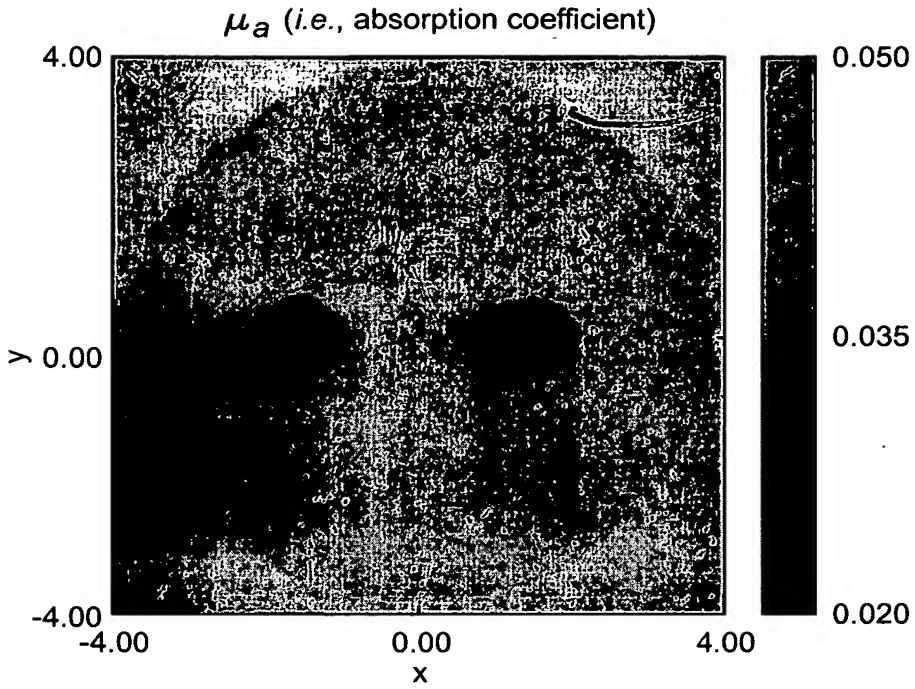
μ_a (*i.e.*, absorption coefficient)
4.00
0.00
-4.00
y
-4.00
0.00
4.00
x
0.050
0.035
0.020

FIG. 2A

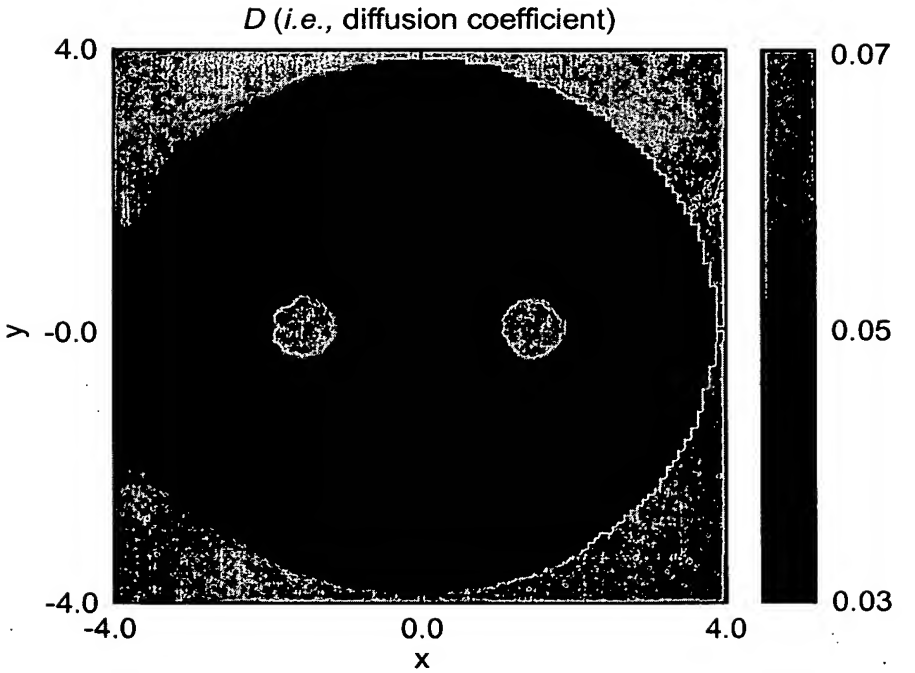
D (*i.e.*, diffusion coefficient)
4.0
-0.0
-4.0
y
-4.0
0.0
4.0
x
0.07
0.05
0.03

FIG. 2B

Test Case		The Parameters Involved					Inverse Algorithms	Result Presented
#	Formulation	I	I_0	I_r	W_r	β		
1	$W_r\delta x = \left(\frac{I - I_0}{I_0}\right) I_r$	C	C	V	V	/	CGD	6x6 Matrix
2	$W_r\delta x = \left(\frac{I - I_0}{I_0}\right) I_r$	C	C	V	V	/	CGD + WMR	6x6 Matrix
3	$W_r\delta x = I - I_r$	C	/	V	V	/	CGD	5x5 Matrix
4	$W_r\delta x = I - I_r$	C	/	V	V	/	CGD + WMR	5x5 Matrix
5	$W_r\delta x = I - I_b$	C	/	C	V	/	CGD	6x6 Matrix
6	$W_b\delta x = I - I_r$	C	/	V	C	/	CGD	5x5 Matrix
7	$W_b\delta x = \beta I - I_b$	C	/	C	C	V	CGD	3x3 Matrix

FIG. 3

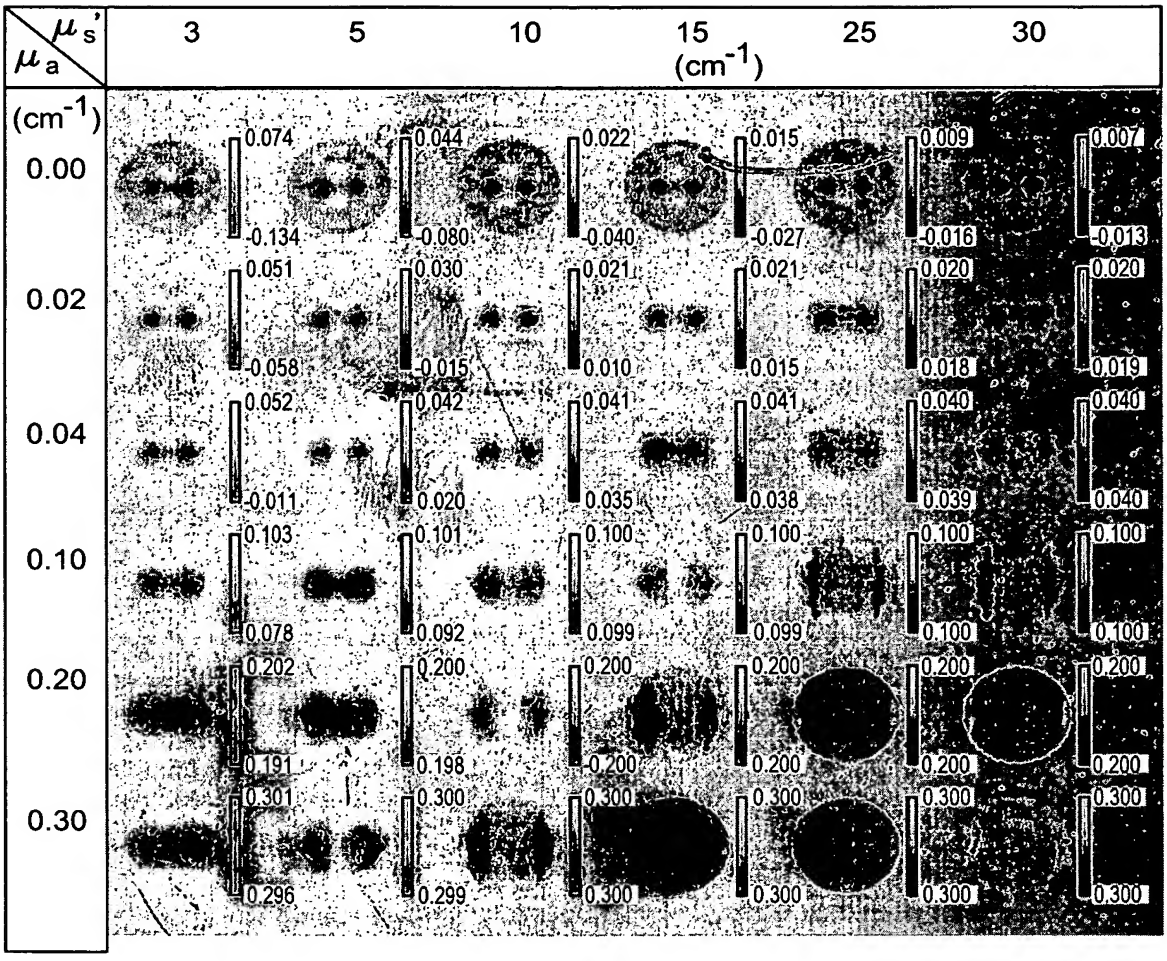
μs'
μa
3
5
10
15
25
30
(cm-1)
(cm-1)
0.00
0.02
0.04
0.10
0.20
0.30
0.074
-0.134
0.044
-0.080
0.022
-0.040
0.015
-0.027
0.009
-0.016
0.007
-0.013
0.051
-0.058
0.030
-0.015
0.021
0.010
0.021
0.015
0.020
0.018
0.020
0.019
0.052
-0.011
0.042
0.020
0.041
0.035
0.041
0.038
0.040
0.039
0.040
0.040
0.103
0.078
0.101
0.092
0.100
0.099
0.100
0.099
0.100
0.100
0.100
0.100
0.202
0.191
0.200
0.198
0.200
0.200
0.200
0.200
0.200
0.200
0.200
0.200
0.301
0.296
0.300
0.299
0.300
0.300
0.300
0.300
0.300
0.300
0.300
0.300

FIG. 4A

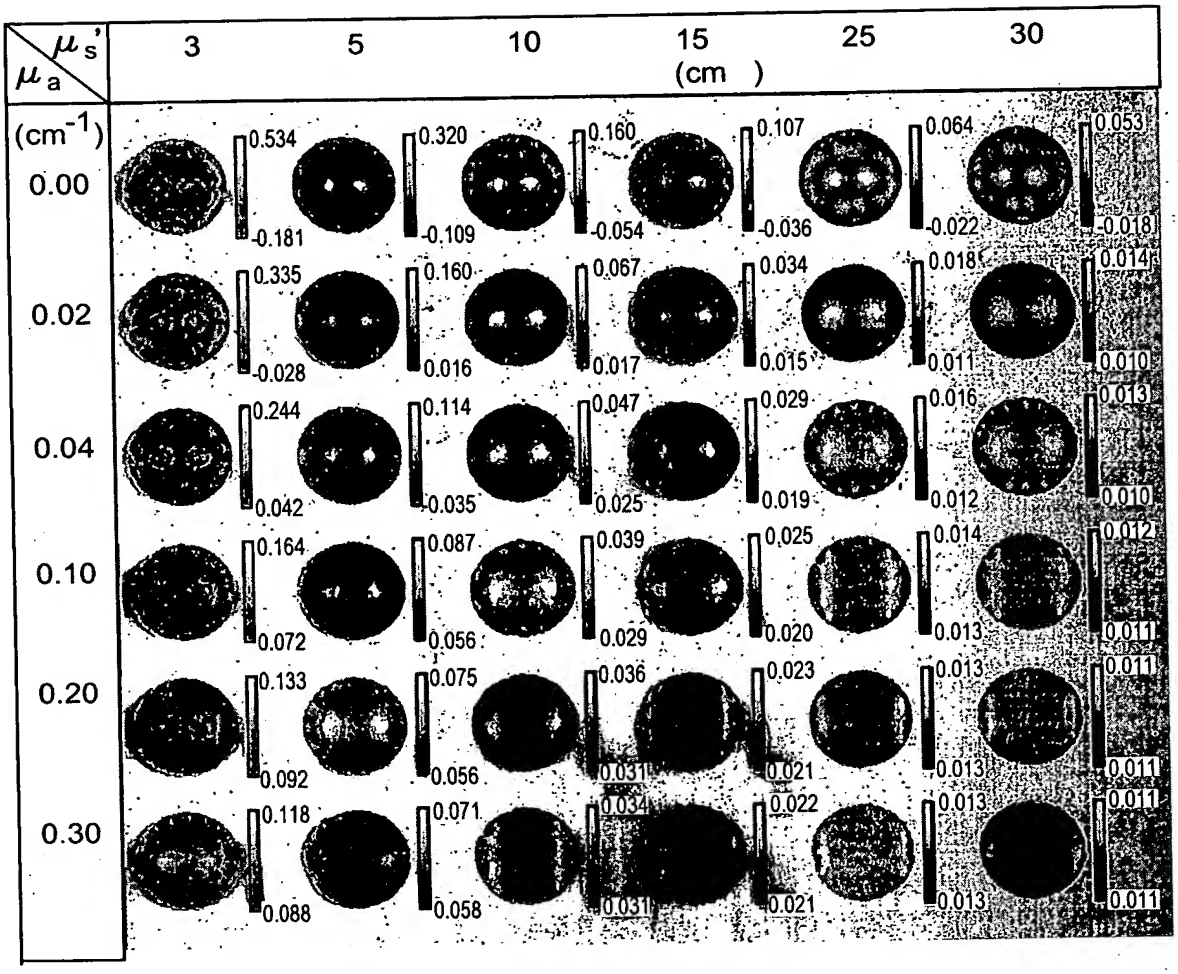
μs'
μa
3
5
10
15
25
30
(cm)
(cm-1)
0.00
0.02
0.04
0.10
0.20
0.30
0.534
-0.181
0.320
-0.109
0.160
-0.054
0.107
-0.036
0.064
-0.022
0.053
-0.018
0.335
-0.028
0.160
0.016
0.067
0.017
0.034
0.015
0.018
0.011
0.014
0.010
0.244
0.042
0.114
-0.035
0.047
0.025
0.029
0.019
0.016
0.012
0.013
0.010
0.164
0.072
0.087
0.056
0.039
0.029
0.025
0.020
0.014
0.013
0.012
0.011
0.133
0.092
0.075
0.056
0.036
0.031
0.023
0.021
0.013
0.013
0.011
0.011
0.118
0.088
0.071
0.058
0.034
0.031
0.022
0.021
0.013
0.013
0.011
0.011

FIG. 4B

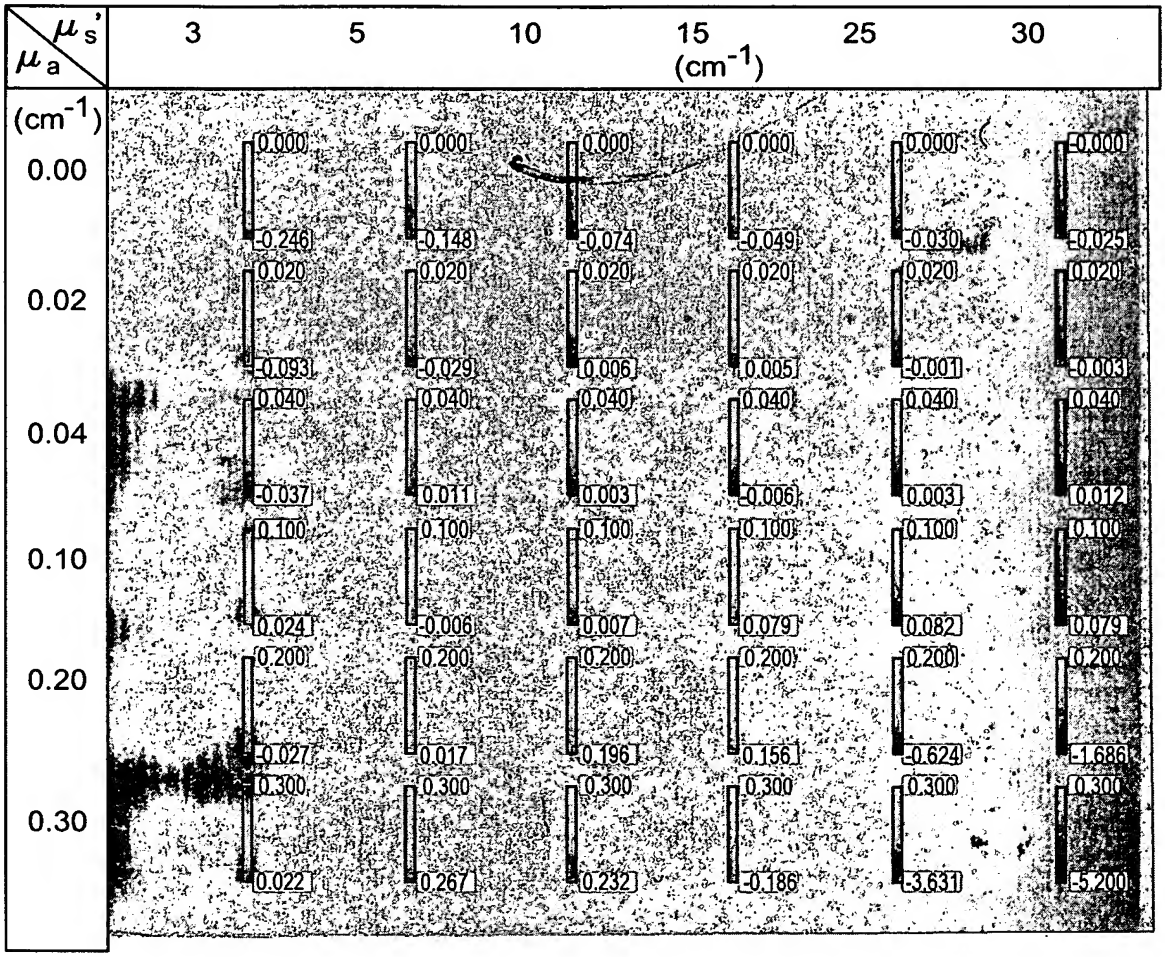
μs'
μa
3
5
10
15
25
30
(cm-1)
(cm-1)
0.00
0.02
0.04
0.10
0.20
0.30
0.000
-0.246
-0.148
-0.074
-0.049
-0.030
-0.025
0.020
-0.093
-0.029
0.006
0.005
-0.001
-0.003
0.040
-0.037
0.011
0.003
-0.006
0.003
0.012
0.100
0.024
-0.006
0.007
0.079
0.082
0.079
0.200
-0.027
0.017
0.196
0.156
-0.624
-1.686
0.300
0.022
0.267
0.232
-0.186
-3.631
-5.200

FIG. 5A

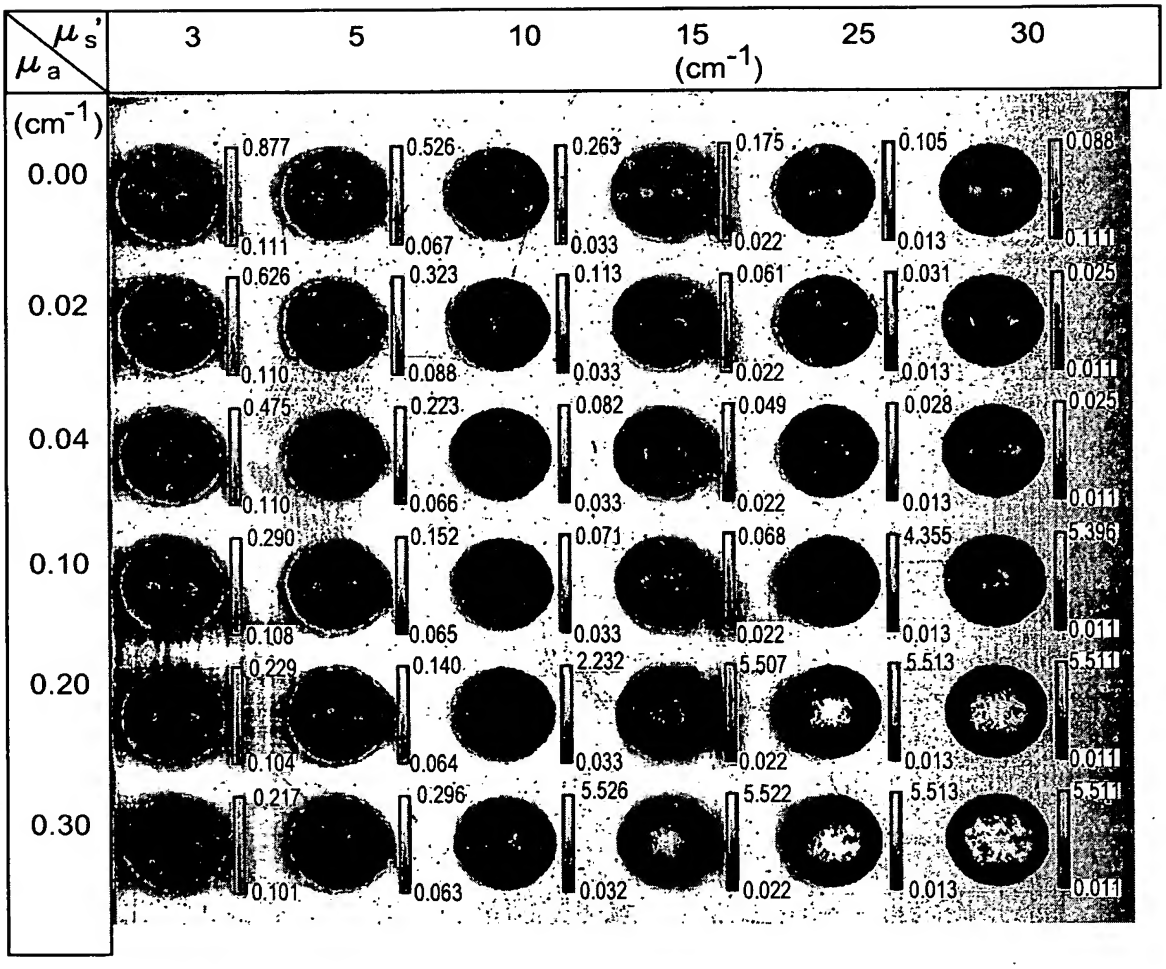
μs' / μa
3
5
10
15
25
30
(cm-1)
(cm-1)
0.00
0.02
0.04
0.10
0.20
0.30
0.877 0.526 0.263 0.175 0.105 0.088
0.111 0.067 0.033 0.022 0.013 0.111
0.626 0.323 0.113 0.061 0.031 0.025
0.110 0.088 0.033 0.022 0.013 0.011
0.475 0.223 0.082 0.049 0.028 0.025
0.110 0.066 0.033 0.022 0.013 0.011
0.290 0.152 0.071 0.068 4.355 5.396
0.108 0.065 0.033 0.022 0.013 0.011
0.229 0.140 2.232 5.507 5.513 5.511
0.104 0.064 0.033 0.022 0.013 0.011
0.217 0.296 5.526 5.522 5.513 5.511
0.101 0.063 0.032 0.022 0.013 0.011

FIG. 5B

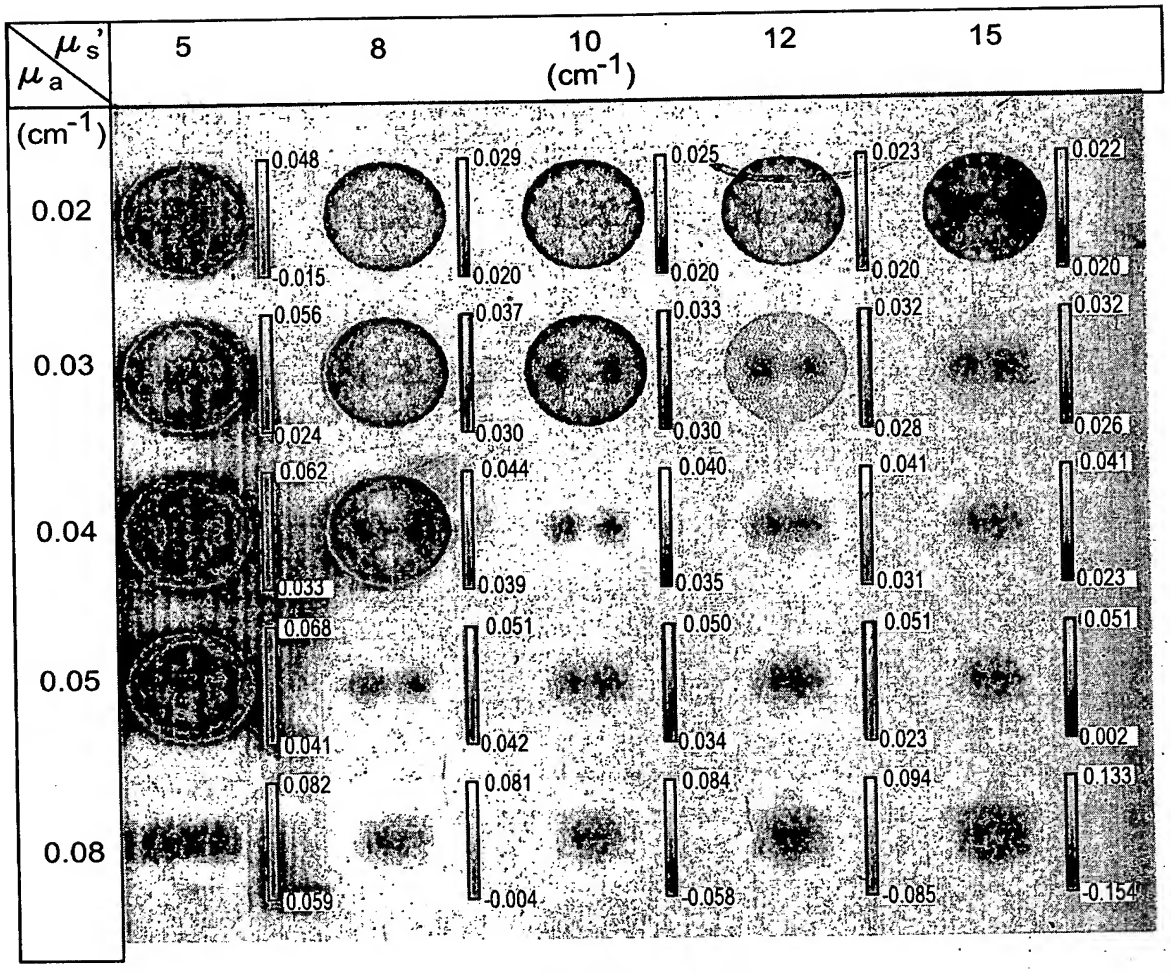
μs'
μa
5
8
10
12
15
(cm-1)
(cm-1)
0.02
0.03
0.04
0.05
0.08
0.048
-0.015
0.029
0.020
0.025
0.020
0.023
0.020
0.022
0.020
0.056
0.024
0.037
0.030
0.033
0.030
0.032
0.028
0.032
0.026
0.062
0.033
0.044
0.039
0.040
0.035
0.041
0.031
0.041
0.023
0.068
0.041
0.051
0.042
0.050
0.034
0.051
0.023
0.051
0.002
0.082
0.059
0.081
-0.004
0.084
-0.058
0.094
-0.085
0.133
-0.154

FIG. 6A

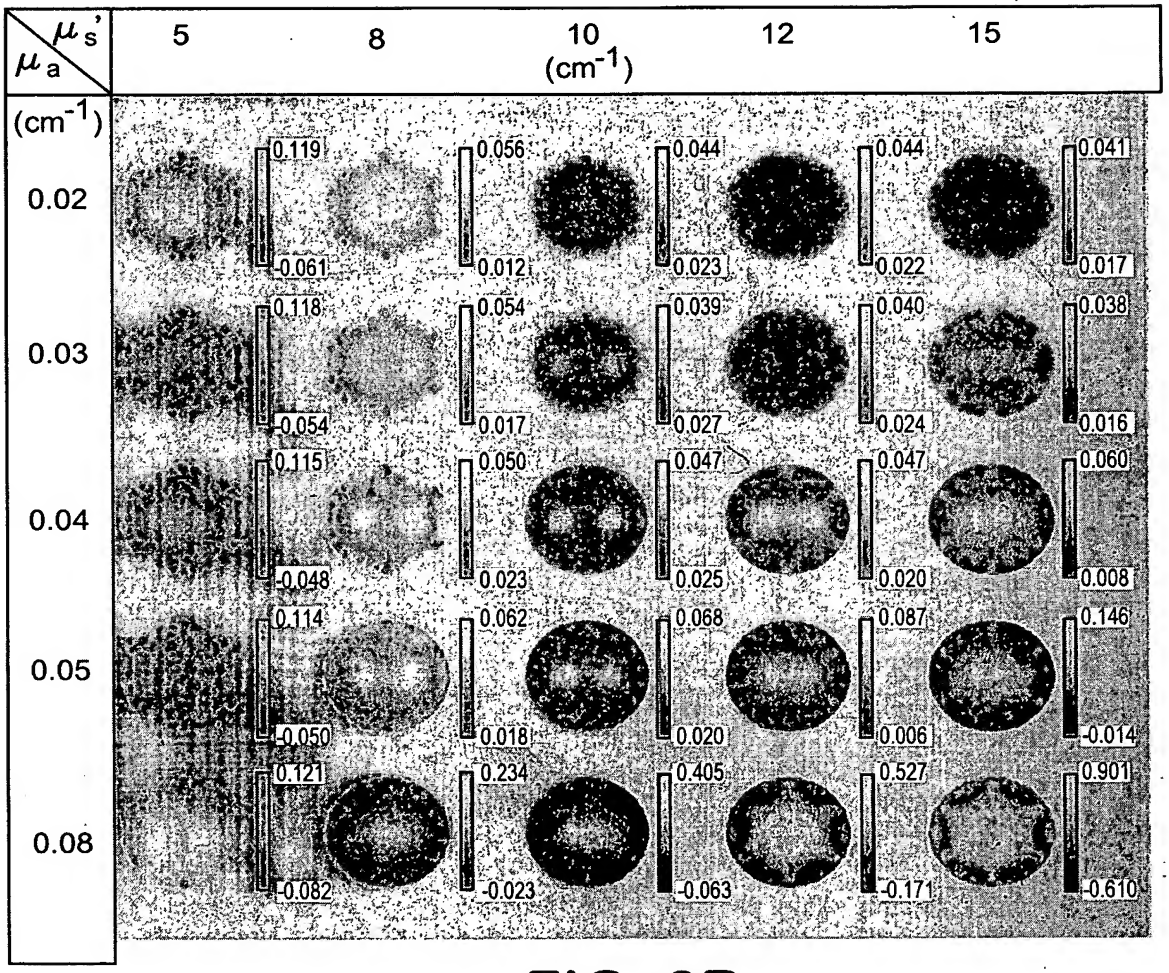
μs'
μa
5
8
10
12
15
(cm-1)
(cm-1)
0.02
0.03
0.04
0.05
0.08
0.119
-0.061
0.056
0.012
0.044
0.023
0.044
0.022
0.041
0.017
0.118
-0.054
0.054
0.017
0.039
0.027
0.040
0.024
0.038
0.016
0.115
-0.048
0.050
0.023
0.047
0.025
0.047
0.020
0.060
0.008
0.114
-0.050
0.062
0.018
0.068
0.020
0.087
0.006
0.146
-0.014
0.121
-0.082
0.234
-0.023
0.405
-0.063
0.527
-0.171
0.901
-0.610

FIG. 6B

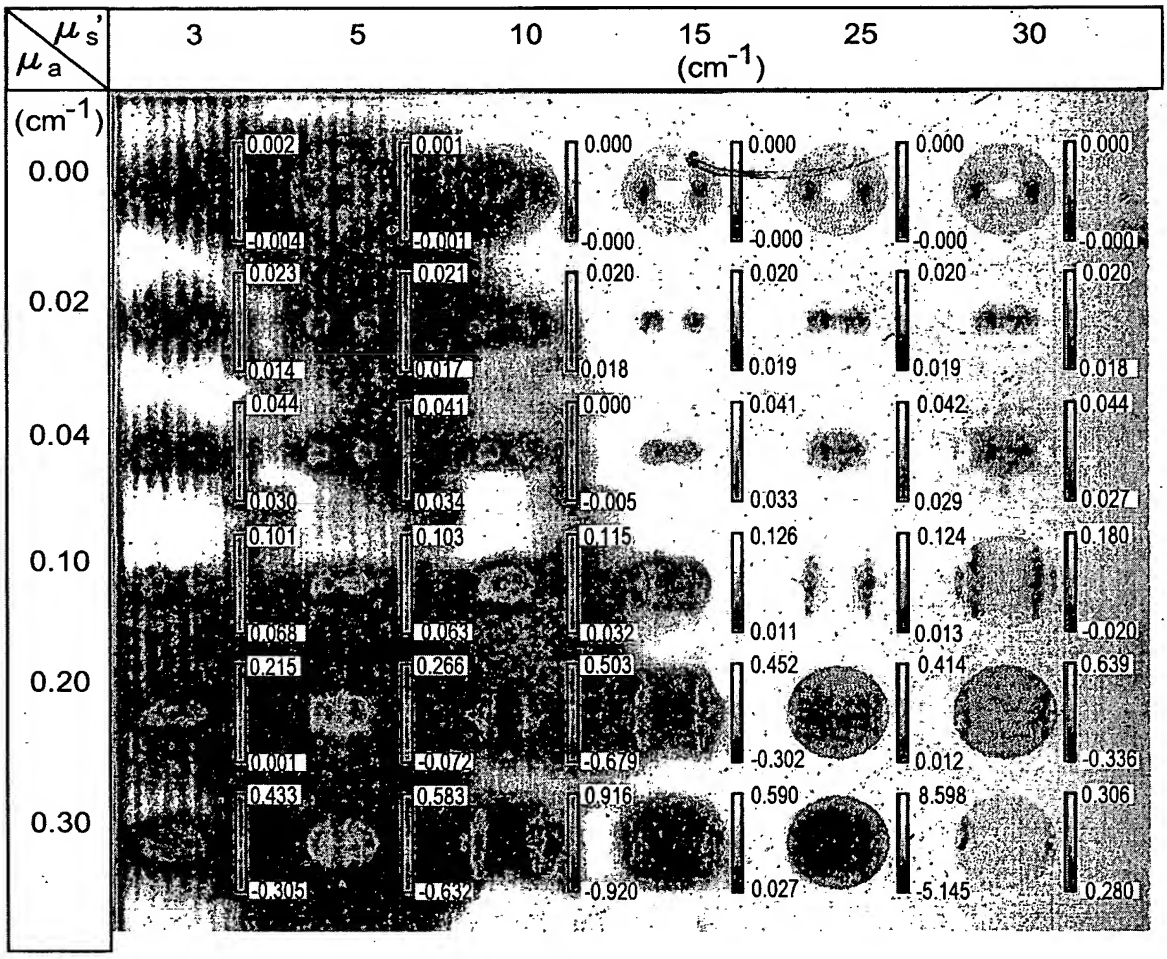
μs'
μa
3
5
10
15
25
30
(cm-1)
(cm-1)
0.00
0.02
0.04
0.10
0.20
0.30
0.002
-0.004
0.001
-0.001
0.000
-0.000
0.000
-0.000
0.000
-0.000
0.000
-0.000
0.023
0.014
0.021
0.017
0.020
0.018
0.020
0.019
0.020
0.019
0.020
0.018
0.044
0.030
0.041
0.034
0.000
-0.005
0.041
0.033
0.042
0.029
0.044
0.027
0.101
0.068
0.103
0.063
0.115
0.032
0.126
0.011
0.124
0.013
0.180
-0.020
0.215
0.001
0.266
-0.072
0.503
-0.679
0.452
-0.302
0.414
0.012
0.639
-0.336
0.433
-0.305
0.583
-0.632
0.916
-0.920
0.590
0.027
8.598
-5.145
0.306
0.280

FIG. 7A

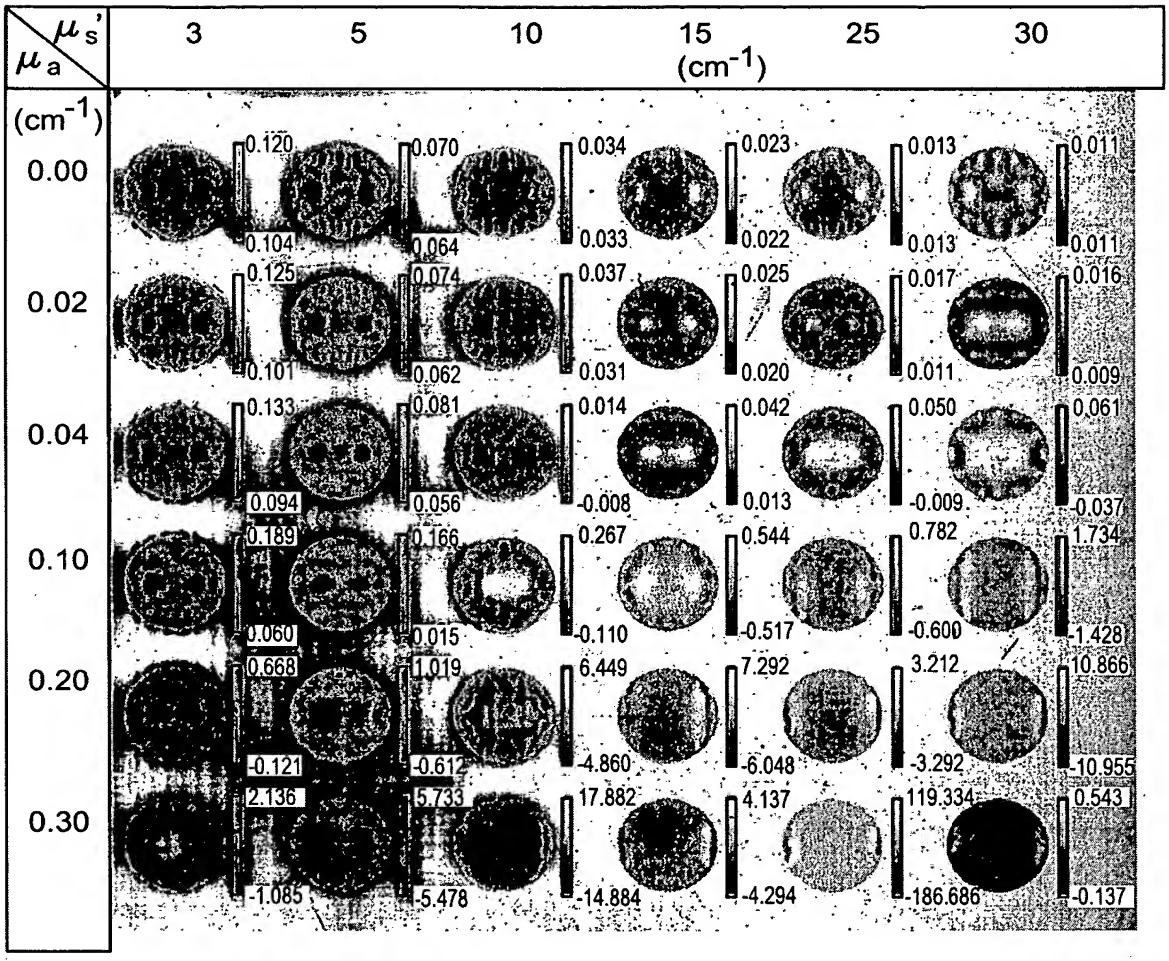
μs'
μa
3
5
10
15
25
30
(cm-1)
(cm-1)
0.00
0.02
0.04
0.10
0.20
0.30
0.120
0.104
0.070
0.064
0.034
0.033
0.023
0.022
0.013
0.013
0.011
0.011
0.125
0.101
0.074
0.062
0.037
0.031
0.025
0.020
0.017
0.011
0.016
0.009
0.133
0.094
0.081
0.056
0.014
-0.008
0.042
0.013
0.050
-0.009
0.061
-0.037
0.189
0.060
0.166
0.015
0.267
-0.110
0.544
-0.517
0.782
-0.600
1.734
-1.428
0.668
-0.121
1.019
-0.612
6.449
-4.860
7.292
-6.048
3.212
-3.292
10.866
-10.955
2.136
-1.085
5.733
-5.478
17.882
-14.884
4.137
-4.294
119.334
-186.686
0.543
-0.137

FIG. 7B

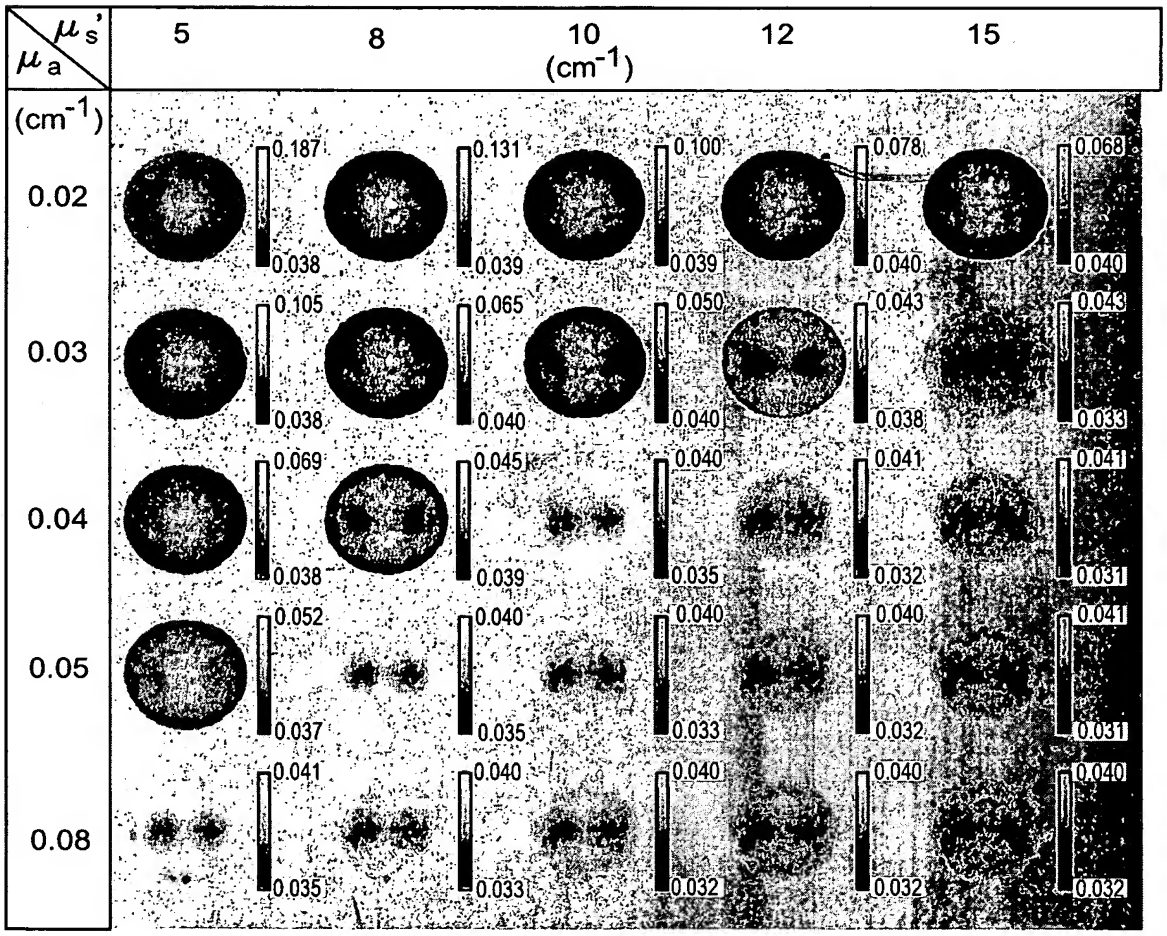
μs'
μa
5
8
10
12
15
(cm-1)
(cm-1)
0.02
0.03
0.04
0.05
0.08
0.187
0.038
0.131
0.039
0.100
0.039
0.078
0.040
0.068
0.040
0.105
0.038
0.065
0.040
0.050
0.040
0.043
0.038
0.043
0.033
0.069
0.038
0.045
0.039
0.040
0.035
0.041
0.032
0.041
0.031
0.052
0.037
0.040
0.035
0.040
0.033
0.040
0.032
0.041
0.031
0.041
0.035
0.040
0.033
0.040
0.032
0.040
0.032
0.040
0.032

FIG. 8A

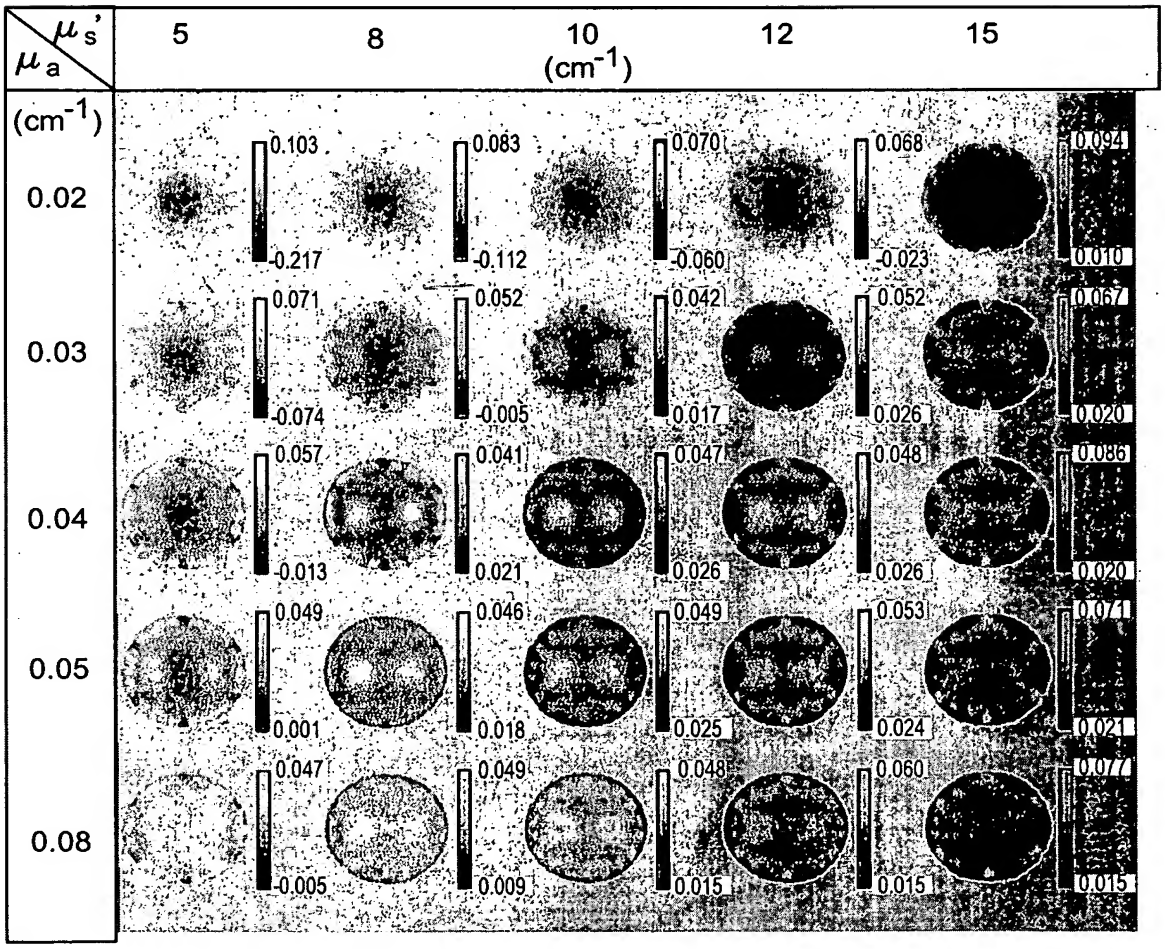
μs'
μa
5
8
10
12
15
(cm-1)
(cm-1)
0.02
0.03
0.04
0.05
0.08
0.103
-0.217
0.083
-0.112
0.070
-0.060
0.068
-0.023
0.094
0.010
0.071
-0.074
0.052
-0.005
0.042
0.017
0.052
0.026
0.067
0.020
0.057
-0.013
0.041
0.021
0.047
0.026
0.048
0.026
0.086
0.020
0.049
0.001
0.046
0.018
0.049
0.025
0.053
0.024
0.074
0.021
0.047
-0.005
0.049
0.009
0.048
0.015
0.060
0.015
0.077
0.015

FIG. 8B

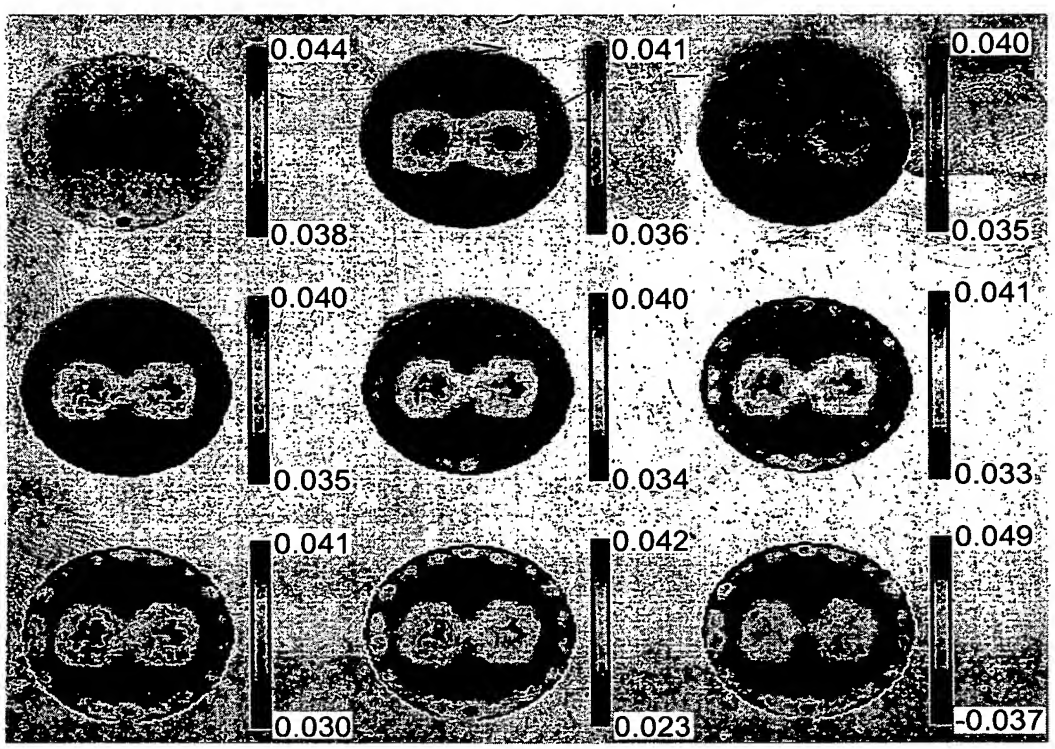
0.044
0.038
0.041
0.036
0.040
0.035
0.040
0.035
0.040
0.034
0.041
0.033
0.041
0.030
0.042
0.023
0.049
-0.037

FIG. 9A

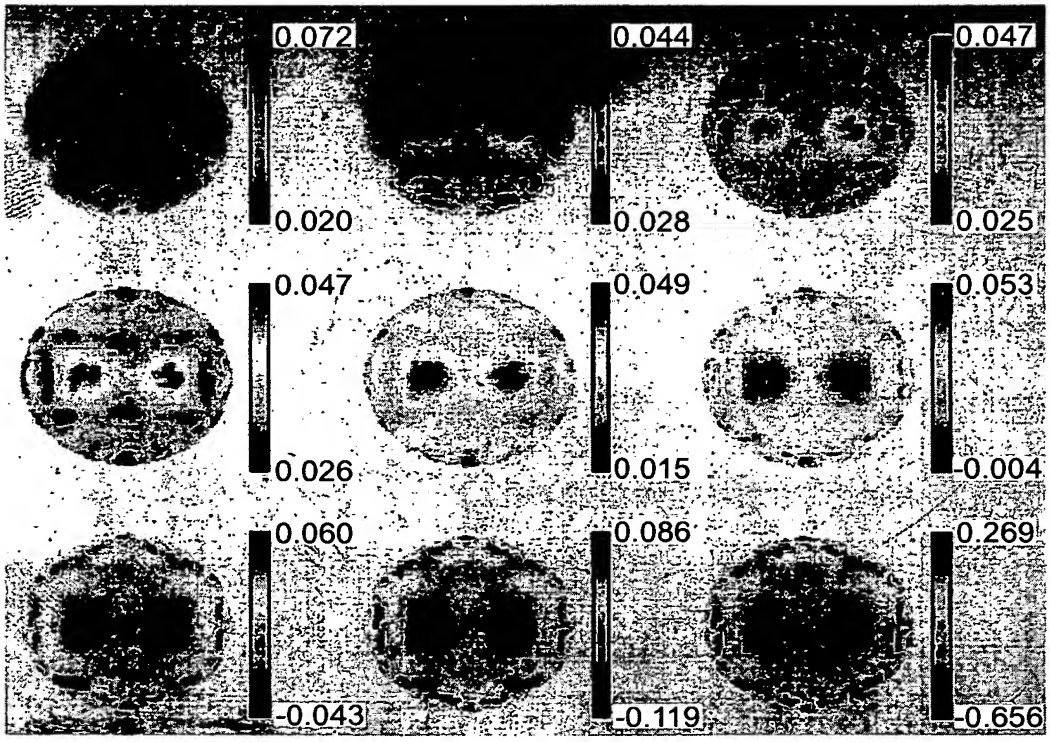
0.072
0.020
0.044
0.028
0.047
0.025
0.047
0.026
0.049
0.015
0.053
-0.004
0.060
-0.043
0.086
-0.119
0.269
-0.656

FIG. 9B

Constant Calibration Errors

-50%	-10%	0%
10%	25%	50%
100%	200%	900%

FIG. 10

Ua						D					
Image RSME						Image RSME					
1.2024	1.0805	1.0229	1.0113	1.0048	1.0036	3.4978	1.8461	0.7665	0.6061	0.6689	0.7096
0.6449	0.5520	0.5181	0.5089	0.5023	0.5010	2.5947	1.0714	0.1394	0.3617	0.6149	0.6787
0.2055	0.0881	0.0791	0.0861	0.0910	0.0917	2.3307	0.9784	0.1396	0.3682	0.6188	0.6825
1.4762	1.5126	1.5330	1.5369	1.5385	1.5386	2.1879	0.9450	0.1638	0.3823	0.6260	0.6876
4.0360	4.0585	4.0677	4.0677	4.0690	4.0690	2.0802	0.9036	0.1742	0.3924	0.6289	0.6897
6.5828	6.5959	6.6002	6.6002	6.6005	6.6005	1.9768	0.8595	0.1795	0.3980	0.6305	0.6909
Object Contrast (True Contrast Value = 0.02 cm^{-1})						Object Contrast (True Contrast Value = 0.0332 cm^{-1})					
0.1418	0.0849	0.0425	0.0284	0.0170	0.0142	0.4091	0.2444	0.1222	0.0819	0.0491	0.0410
0.0899	0.0425	0.0132	0.0066	0.0025	0.0017	0.2466	0.1155	0.0341	0.0165	0.0064	0.0048
0.0639	0.0262	0.0076	0.0035	0.0008	0.0005	0.1723	0.0675	0.0189	0.0096	0.0029	0.0021
0.0315	0.0121	0.0020	0.0007	0.0001	0.0000	0.0779	0.0313	0.0071	0.0036	0.0004	0.0003
0.0141	0.0037	0.0004	0.0001	0.0000	0.0000	0.0431	0.0133	0.0031	0.0006	0.0001	0.0001
0.0063	0.0017	0.0001	0.0000	0.0000	0.0000	0.0219	0.0098	0.0009	0.0002	0.0000	0.0000
Edge Resolution (Actual FWHM = 1 cm)						Edge Resolution (Actual FWHM = 1 cm)					
1.2656	1.2656	1.2656	1.2656	1.2656	1.2656	1.1707	1.1707	1.1707	1.1707	1.1707	1.1707
1.3922	1.5187	1.6137	1.7402	2.0250	2.0566	1.2340	1.2978	1.2973	1.3605	1.6137	1.6453
1.5504	1.6137	1.8035	2.0566	2.1832	1.5187	1.2973	1.2973	1.4238	1.6453	1.3605	1.1074
1.7402	2.0250	2.1832	1.3289	1.1391	1.0441	1.3605	1.6137	1.3605	1.2973	0.9809	0.9492
2.1516	2.0883	1.3289	1.0441	0.6328	0.6645	1.6453	1.3605	1.2023	0.9492	0.6012	0.6645
2.1832	1.3605	1.0441	0.6328	0.6645	0.3480	1.3605	1.2656	0.9492	0.3480	0.6328	0.2215

FIG. 11

Ua						D					
Image RSME						Image RSME					
1.1171	1.0615	1.0272	1.0173	1.0100	1.0082	2.9455	1.4274	0.4252	0.3957	0.5926	0.6555
0.5662	0.5251	0.5061	0.5029	0.5020	0.5019	2.6397	1.1522	0.1382	0.3447	0.6095	0.6763
0.1143	0.0560	0.0511	0.0586	0.0598	0.0748	2.4602	1.0394	0.1042	0.3594	0.6135	0.6750
1.4935	1.5003	1.5152	1.5359	1.5373	1.5350	2.2413	0.9426	0.1317	0.3578	6.9283	15.892
4.0029	4.0296	4.0678	4.0614	4.0810	4.6830	2.0733	0.9074	2.9287	23.021	59.515	66.122
6.5353	6.5962	6.5889	6.5719	9.4904	24.8398	1.9857	1.0638	30.856	58.531	73.635	78.807
Object Contrast (True Contrast Value = 0.02 cm^{-1})						Object Contrast (True Contrast Value = 0.0332 cm^{-1})					
0.0017	0.0010	0.0005	0.0003	0.0002	0.0002	0.3790	0.2274	0.1137	0.0758	0.0455	0.0379
0.0044	0.0053	0.0078	0.0089	0.0105	0.0111	0.2697	0.1377	0.0474	0.0239	0.0088	0.0056
0.0127	0.0157	0.0199	0.0221	0.0153	0.0105	0.2035	0.0938	0.0281	0.0112	0.0057	0.0051
0.0446	0.0531	0.0376	0.0056	0.0004	0.0017	0.1138	0.0419	0.0142	0.0106	0.0141	0.6339
0.1072	0.0724	0.0003	0.0035	0.0001	0.0002	0.0503	0.0277	0.0145	1.9047	6.4243	6.8546
0.1169	0.0080	0.0044	0.0015	0.0050	0.1918	0.0433	0.0289	2.4170	6.2687	7.6970	8.7233
Edge Resolution (Actual FWHM = 1 cm)						Mean FWHM (Actual FWHM = 1 cm)					
3.2590	3.2590	3.2590	3.2590	3.2590	3.2590	0.7594	0.7594	0.7594	0.7594	0.7594	0.7594
0.5062	0.6012	0.6328	0.6961	0.6328	0.6328	0.7594	0.7594	0.7910	0.7594	0.7594	0.4746
0.5379	0.6328	0.6645	0.6328	0.5062	0.4113	0.7910	0.7910	0.8227	0.4746	0.4113	0.3797
0.6961	0.6328	0.4430	0.3797	0.1582	0.2531	0.7594	0.7277	0.4113	0.4113	0.2215	1.8035
0.6012	0.4746	2.8477	0.2531	0.1898	0.1898	0.4746	0.3797	0.1898	0.3480	3.0059	3.0059
0.5062	0.4113	0.2215	0.1898	0.3797	0.0949	0.3797	0.3164	0.3797	3.0059	3.0059	3.4488

FIG. 12

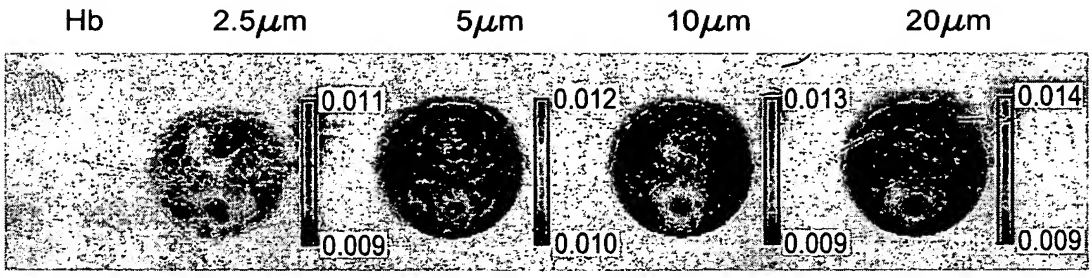

FIG. 13A

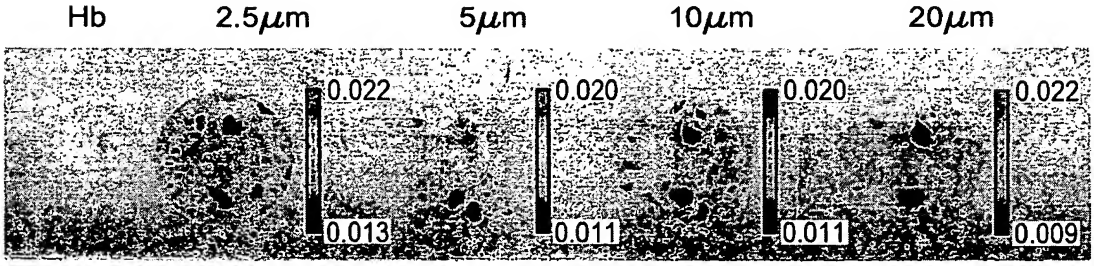

FIG. 13B

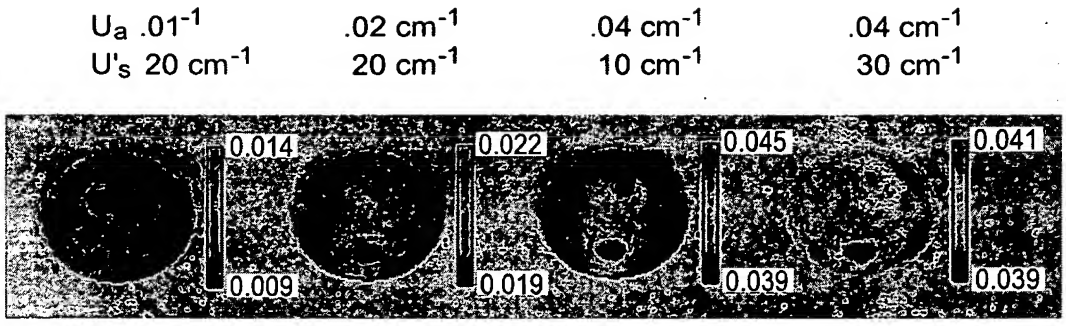

FIG. 14A

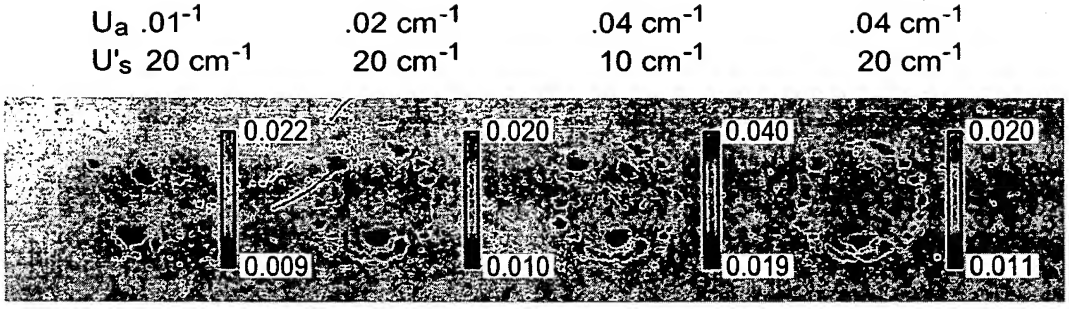

FIG. 14B

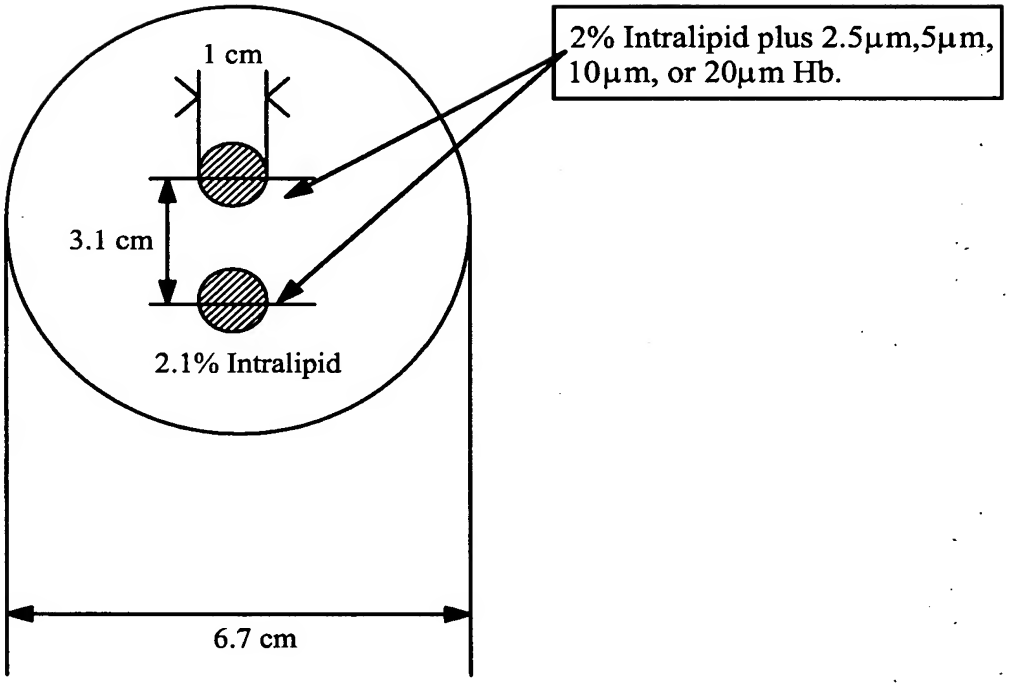
2% Intralipid plus 2.5μm,5μm, 10μm, or 20μm Hb.
1 cm
3.1 cm
2.1% Intralipid
6.7 cm

FIG. 15

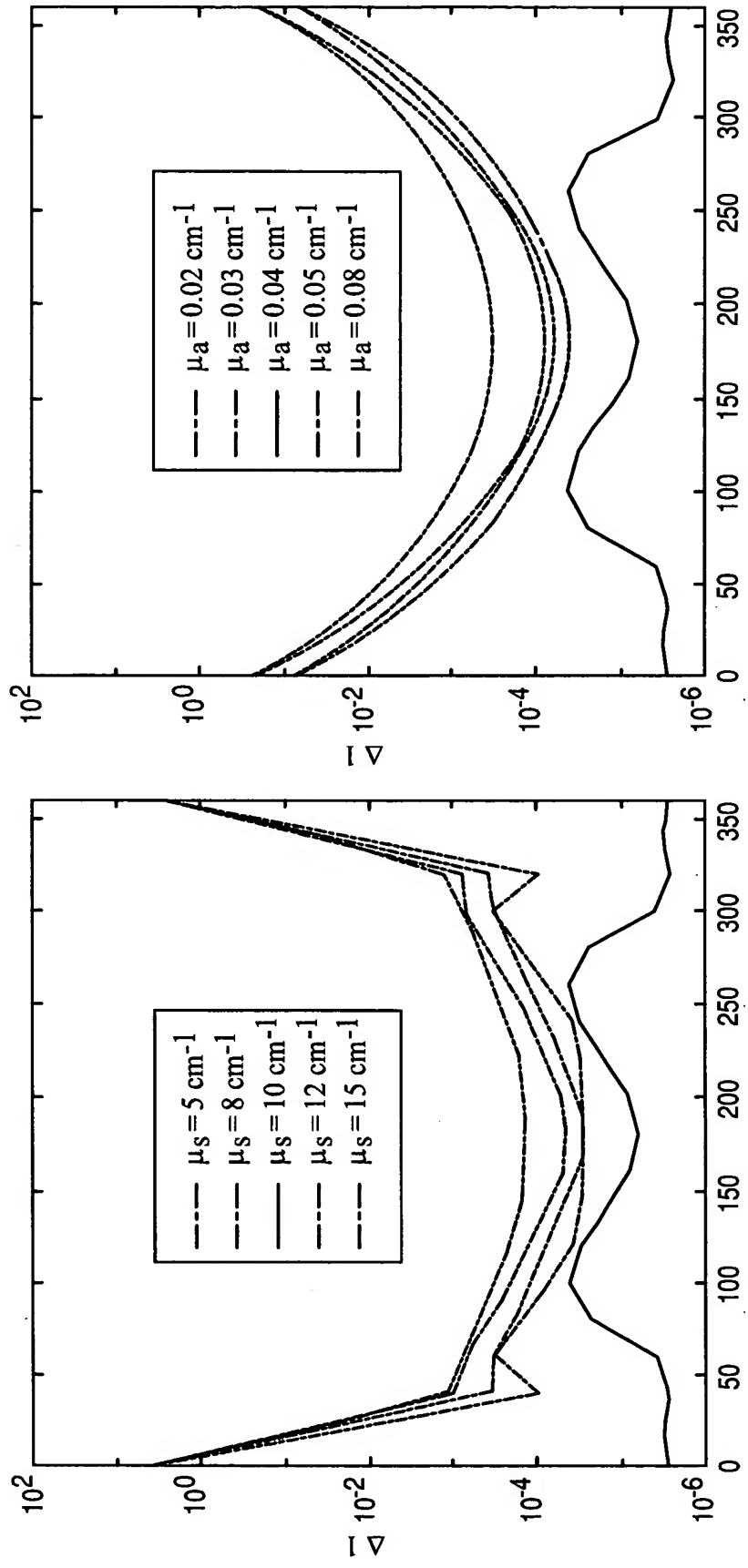

FIG. 16A

FIG. 16B

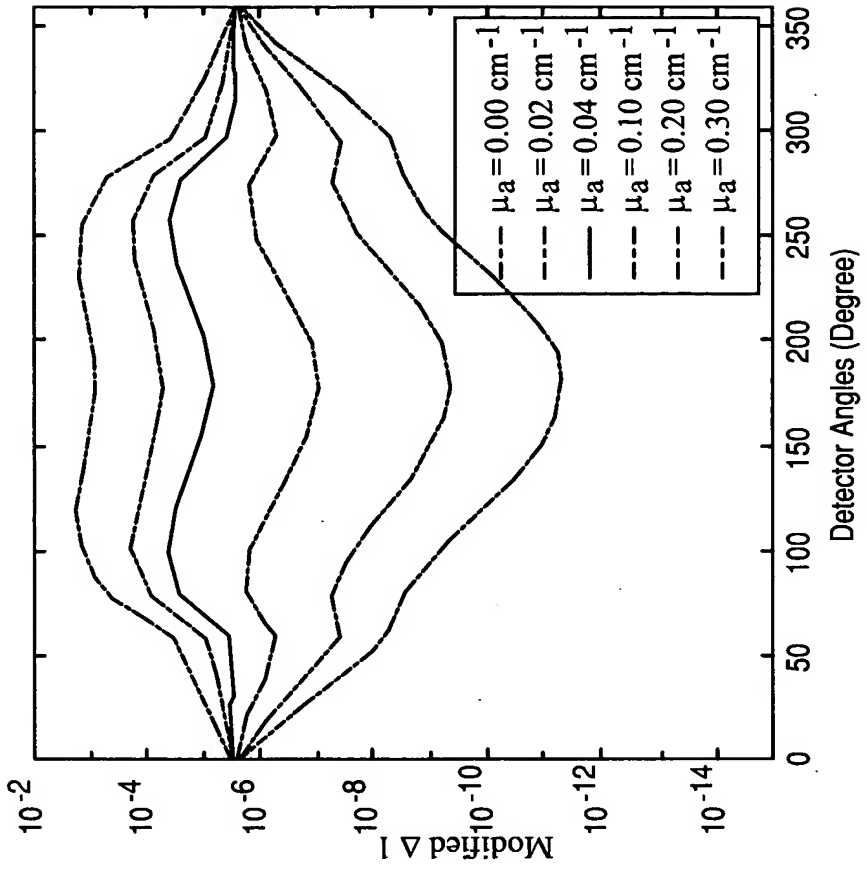

FIG. 17B

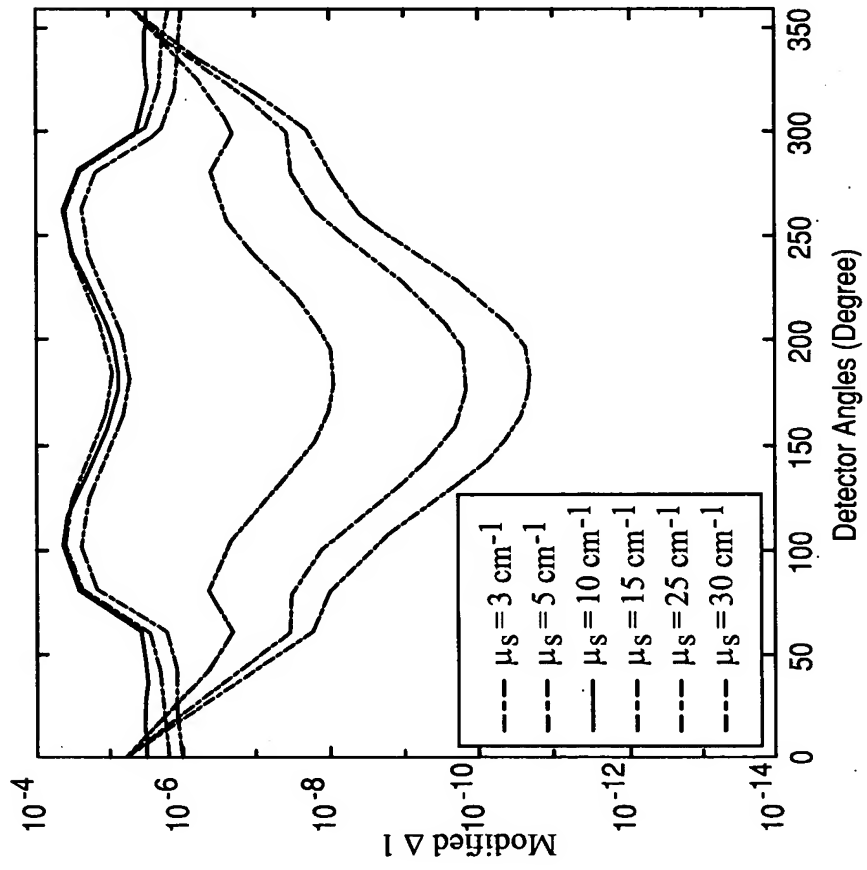

FIG. 17A

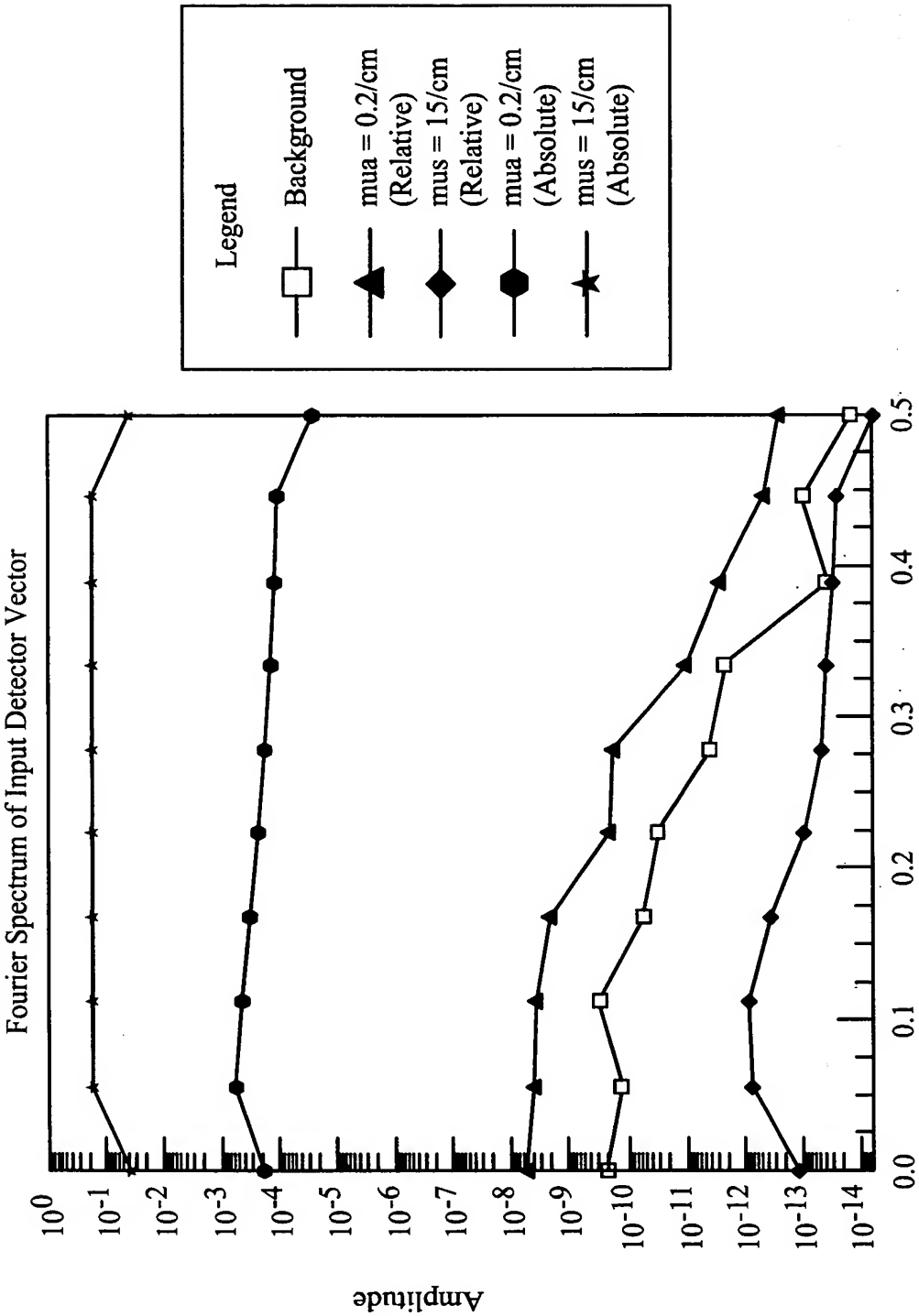
Legend
Background
mua = 0.2/cm (Relative)
mus = 15/cm (Relative)
mua = 0.2/cm (Absolute)
mus = 15/cm (Absolute)
Fourier Spectrum of Input Detector Vector
Amplitude
Frequency
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
10^{-13}
10^{-14}
0.0
0.1
0.2
0.3
0.4
0.5

FIG. 18

Original ratio = $\delta\mu/\delta D=0.02/0.0332=0.6024$

$(\delta\mu_4/\delta D)^{1/2}=0.3626$

$\mu_2(cm^{-1})$

$\mu_2(cm^{-1})$	7	5	10	15	25	30
0.00	0.3427	0.3435	0.3441	0.3429	0.3427	0.3429
0.02	0.3627	0.3682	0.3882	0.4000	0.3846	0.3469
0.04	0.3715	0.3887	0.4042	0.3608	0.2758	0.2380
0.10	0.4048	0.3817	0.2816	0.1891	0.2000	0.0000
0.20	0.3463	0.2761	0.1212	0.1428	0.0000	0.0000
0.30	0.2863	0.1683	0.1000	0.0000	-NAN	-NAN

FIG. 19